

## CLAIMS

### What Is Claimed Is:

1. A breast pump system, comprising:
  - a collapsible breast cup;
  - a container attached to the breast cup for collecting breast milk;
  - a vacuum line with a first and second end, the first end being attached to the breast cup;
  - a pump having an input and an output, the input being attached to the second end of the vacuum line for drawing a vacuum in the breast cup, causing milk to be extracted from the breast; and
  - a biological filter having an input and an output connected between the breast cup and the input to the pump in the vacuum line, for preventing contamination between the pump and the breast cup.
2. The breast pump system of claim 1 wherein the breast cup is made of silicone material.
3. The breast pump system of claim 1 wherein the container further comprises a cap threadable to the top of the container.
4. The breast pump system of claim 1 wherein the pump is piston driven by a variable speed DC motor.
5. The breast pump system of claim 1 wherein the biological filter is a 60 mm, 1.0 micron filter.
6. The breast pump system of claim 1 further comprising a second filter in the vacuum line between the biological filter and the input of the pump.

7. The breast pump system of claim 6 further comprising:  
a vacuum line connected between the input to the second filter and the out put of the pump; and  
a valve in the vacuum line between the second filter and the pump output.
8. The breast pump system of claim 1 further comprising a third filter connected to the output of the pump.
9. The breast pump system of claim 1 further comprising a vacuum sensor connected to the vacuum line for monitoring the vacuum level in the line.
10. The breast pump system of claim 9 further comprising a control circuit response to the vacuum level sensed by the vacuum sensor for regulating the speed of the pump.
11. The breast pump system of claim 10 further comprising a manual control connected to the control circuit for adjusting the cycling of the pump.
12. The breast pump system of claim 1 wherein the biological filter is connected to the input of the pump by a push-in connection.
13. The breast pump system of claim 12 wherein the push-in connection comprises:  
a female channel connected to one end of a vacuum line attached to the input of the pump; and  
a male extension attached to the output of the biological filter, the extension sized to fit into the female channel.

14. The breast pump system of claim 13 wherein the male extension further comprises:

a pair of sealing O-rings displaced along the length of the male extension, wherein one O-ring has a greater thickness than the other.

15. The breast pump system of claim 13 wherein the male extension is tapered along its length from a larger diameter, where it attaches to the filter, to a smaller diameter.

16. A breast pump system comprising:

a flexible breast cup;

a container attached to the breast cup for collecting breast milk;

a vacuum line with a first and second end, the first end being attached to the flexible breast cup;

a pump having an input and an output, the input being attached to the second end of the vacuum line for drawing a vacuum in the breast cup causing milk to be extracted from the breast; and

a vacuum control circuit for controlling the length of time that a vacuum is drawn in the breast cup and the length of time that no vacuum is drawn in the breast cup.

17. The breast pump system of claim 16 further comprising a biological filter having an input and an output connected into the vacuum line between the breast cup and the input to the pump for preventing contamination between the pump and the breast cup.

18. The breast pump system of claim 16 wherein the pump is a piston pump driven by a variable speed DC motor.

19. The breast pump system of claim 16 further comprising a vacuum sensor for monitoring the vacuum in the line, the vacuum control circuit being responsive to the vacuum sensor.

20. The breast pump system of claim 16 further comprising:

a vacuum line connected between the input to the pump and the output to the pump; and

a valve in the vacuum line between the pump input and output;

the vacuum control circuit opening and closing the valve to control the length of time that a vacuum is drawn and the length of time that no vacuum is drawn.

21. A breast pump comprising:

a pump having an input and an output being connected for applying pressure to a breast in a breast cup; and

a control circuit for controlling the length of time that continuous pressure is applied to a breast in a breast cup and the length of time that no pressure is applied to the breast in the breast cup.

22. A breast cup for use in a breast pump system comprising:

a cup of biocompatible material having a first cross-section and an opening at a first end, and a second cross-section and an opening at a second end, the wall thickness of the cup varying from the first end to the second end in a manner that causes a progressive collapse of the cup when a vacuum is drawn at the first end, and the second end of the cup is closed by a human breast and teat.

23. The breast cup of claim 22 wherein the wall of the cup closer to the second end is thinner than the wall at the first end so that the breast cup collapses first on the breast and then on the teat.

24. The breast cup of claim 22 wherein the first cross-section remains constant for more than half the length of the cup from the first end to the second end.

25. The breast cup of claim 22 wherein the second cross-section is conical in shape tapering from a first cross-section to a larger second cross-section.

26. The breast cup of claim 25 wherein the wall of the cup is thinner above the transition area between the first cross-section and the second cross-section.

27. The breast cup of Claim 22 wherein the wall of the cup on the areola area of a human breast is thinner.

28. The breast cup of claim 22 wherein the biocompatible material is a silicone.

29. The breast cup of claim 22 further comprising a holder having a first and a second end for covering the breast cup.

30. The breast cup of claim 29 wherein the cup is held by the conical holder at the first end of the cup and holder and at the second end of the cup and holder.

31. The breast cup of claim 30 wherein the second end of the breast cup is forced against the second end of the holder by a force directed to the first end of the cup and holder.

32. The breast cup of claim 31 wherein the first end of the breast cup is forced against the first end of the holder by a force directed to the second end of the cup and holder.

33. A bottle cap for attachment to a collection bottle and a breast cup having a discharge end, for use in a breast pump system, the bottle cap comprising:

a cylinder with internal threads adapted to engage the threads on the collection bottle, one end of the cylinder being closed;

a first tube connector formed as part of the closed end of the cylinder with a passageway through the closed end of the cylinder extending into the collection bottle, the first tube connector adapted to be connected to the breast cup; and

a second tube connector formed as part of the closed end of the cylinder with a passageway through the closed end of the cylinder, the second tube connector adapted to be connected to a vacuum tube.

34. The bottle cap of claim 33 wherein the first tube connector has a hollow male extension inside a female receptacle, the discharge end of the breast cup having an aperture therein for receiving the hollow male extension when the discharge end of the breast cup is inserted into the female receptacle.

35. The bottle cap of claim 34 wherein the passageway of the first tube connector extending into the collection bottle is a tube connected to the male extension at one end and having an opening at the other end located below the closed end of the cylinder.

36. The bottle cap of claim 35 wherein the passageway of the second tube connector has an opening at a first end for connection to the vacuum tube and an opening at a second end in the closed end of the cylinder.